REMARKS

Claims 4-17 and 58-60 are all of the claims presently pending in the application. Claims 4-5, 7, 9 and 11-16 have been amended to more particularly define the invention. Claims 58-60 have been added to claim additional features of the invention.

Non-elected claims 18-57 have been canceled. Applicant explicitly reserves the right to file a Divisional Application for the non-elected claims 18-57 later.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 4-13 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Takeuchi, et al. (U.S. Patent No. 5,239,188) (hereinafter "Takeuchi"). Claims 14-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Takeuchi.

These rejections are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

The claimed invention (e.g., as defined by claim 4) is directed to a group III nitride compound semiconductor. The semiconductor includes a substrate, a buffer layer formed on the substrate into an island pattern having any of a dot pattern, a striped pattern, and a grid pattern such that substrate-exposed portions are formed in a scattered manner, a first group III nitride compound semiconductor layer $Al_{x1}Ga_{y1}In_{1-x1-y1}N$ formed on said buffer layer, a second group III nitride compound semiconductor layer $Al_{x2}Ga_{y2}In_{1-x2-y2}N$ which causes epitaxial growth from at least an island of the first group III nitride compound semiconductor serving as nuclei so that the second group III nitride compound semiconductor keeps a gap to the substrate-exposed portions and connects adjacent ones of the first group III nitride compound semiconductor, and a device layer made of gallium nitride group compound semiconductor formed on the second group III nitride compound semiconductor layer.

Conventional gallium nitride group compound semiconductors are direct-transition type semiconductors having a wide emissions spectrum range from ultraviolet to red, and is applied to light emitting devices such as light-emitting diodes and laser diodes. The gallium nitride group compound semiconductor is generally formed on a sapphire substrate. When a layer of gallium nitride group compound semiconductor is formed on a sapphire substrate, however, cracking and warpage usually occurs in the semiconductor layer due to a difference in thermal coefficient between sapphire and the gallium nitride group compound semiconductor and dislocations are generated in the semiconductor layer due to misfit, resulting in degraded device characteristics.

The claimed invention of exemplary claim 4, on the other hand, provides a group III nitride compound including a second group III nitride compound semiconductor layer which causes epitaxial growth from at least an island of the first group III nitride compound semiconductor serving as nuclei so that the second group III nitride compound semiconductor keeps a gap to the substrate-exposed portions and connects adjacent ones of the first group III nitride compound semiconductor (e.g., see Application at Figure 2A). This combination of features provides a layer of a gallium nitride group compound semiconductor without cracks and dislocations to thereby improve device characteristics (see Application at page 2, lines 10-14).

II. THE PRIOR ART REFERENCE

The Examiner alleges that Takeuchi teaches the claimed invention of claims 4-13. Furthermore, the Examiner alleges that the claimed invention of claims 14-17 would be obvious in view of Takeuchi. Applicant submits, however, that there are elements of the claimed invention which are neither taught nor suggested by Takeuchi.

That is, Takeuchi does not teach or suggest that "*said second group III nitride compound semiconductor keeps a gap to said substrate-exposed portions*" as recited in claim 4 (and similarly recited in claims 5, 7, 9, 11-12, 14 and 16).

The novel features of the claimed invention are not taught or suggested by Takeuchi. The Examiner attempts to rely on Figures 4A-4D and 5, and column 6, lines 5-56 of Takeuchi to support his allegations. The Examiner, however, is clearly incorrect.

Nowhere in these Figures nor this passage (nor anywhere else for that matter) does Takeuchi teach or suggest a second group III nitride compound semiconductor layer which causes epitaxial growth from at least an island of the first group III nitride compound semiconductor serving as nuclei so that the second group III nitride compound semiconductor keeps a gap to the substrate-exposed portions. In fact, the Examiner does not even allege that

Takeuchi teaches or suggests that the second group III nitride compound semiconductor keeps a gap to the substrate-exposed portions.

Indeed, an object of Takeuchi's invention is to form an AlGaInN layer on a silicon substrate (see column 1, lines 7-16 of Takeuchi). That is because the silicon substrate can have high conductivity, which is different from a sapphire substrate, and electric current can be provided to the AlGaInN layer formed on the silicon substrate through the substrate (see column 1, lines 42-44 and 53-61 of Takeuchi). A single crystal AlGaInN layer, however, cannot be formed directly on the silicon substrate (see column 2, line 55 through column 3, line 3 of Takeuchi).

In order to solve this problem, Takeuchi forms an AlN thin film on the silicon substrate and then grows an AlGaInN layer thereon. As a result, a single crystal AlGaInN layer can be obtained (see column 3, lines 29-49 of Takeuchi). However, because AlN is an insulator, the AlGaInN layer is insulated from the silicon substrate. Therefore, it is impossible to provide a larger electric current to the AlGaInN through the substrate (column 5, lines 38-44).

In order that the AlGaInN layer can electrically conduct with the silicon substrate, the AlN middle layer is formed in a striped pattern, which exposes the silicon substrate in the striped pattern. On the exposed portion of the substrate, the AlGaInN layer is directly formed to have a polycrystalline structure, and electric current can be obtained through the polycrystalline AlGaInN layer and the exposed portion of the silicon substrate (column 5, lines 47-64).

Thus, silicon at the substrate-exposed portions is chemically combined with the polycrystalline AlGaInN. Alternatively, the exposed portion of the silicon substrate is formed to have an extremely smaller width than a width of the AlN layer and the AlGaInN layer is formed thereon. Then, at the exposed portion with the extremely smaller width, the AlGaInN formed on the AlN layer also grows on the substrate-exposed portion, thereby enabling the AlGaInN layer to electrically conduct with the silicon substrate (see column 6, lines 7-24). Accordingly, the AlGaInN layer and the silicon substrate are combined chemically at the substrate-exposed portion because of electrical conduction.

As explained above, the silicon substrate and the AlGaInN layer must be combined chemically in Takeuchi's invention, which means that the AlGaInN layer grown on the substrate-exposed portion contacts with the substrate. There is no gap between the AlGaInN layer and the substrate in Takeuchi's invention.

On the contrary, as shown in Figure 2A of the Application, and as defined by independnet claims 4-5, 7, 9, 11-12, 14 and 16, there is a gap between the second group III nitride compound semiconductor layer 3 and the exposed plane of the silicon substrate 1 where the buffer layer 21 is not formed in the present invention. When a gap exists between the substrate and the second group III nitride compound semiconductor, no stress from the substrate may be applied to the second group III nitride compound semiconductor formed on the gap, thereby enabling the invention to provide an excellent crystal.

Moreover, Takeuchi does not disclose or suggest decreasing the threading dislocations in the AlGaInN layer formed on the substrate-exposed portion, as defined by the present invention, to improve the crystallinity of the AlGaInN layer formed on the substrate-exposed portion more than that of the AlGaInN layer formed on the AlN layer. In short, Takeuchi forms a device on the AlGaInN layer formed on the AlN layer, not on the AlGaInN layer formed on the substrate-exposed portion.

On the contrary, in the claimed invention, threading dislocations of the second group III nitride compound semiconductor layer formed on the substrate-exposed portion are decreased, and crystallinity of the second group III nitride compound semiconductor layer formed on the substrate-exposed portion is remarkably improved compared with the second group III nitride compound semiconductor layer formed on the buffer layer. Accordingly, a device such as a laser diode may be formed on the second group III nitride compound semiconductor layer formed on the substrate-exposed portion in the present invention.

As described above, the present invention is completely different from Takeuchi's invention which aims to obtain conductivity toward the substrate. Thus, the present invention would not have been obvious from Takeuchi's invention.

Furthermore, Takeuchi fails to disclose or suggest the first group III nitride compound semiconductor layer on the buffer layer, as defined by claims 4-5, 7, 9, 11-12, 14 and 16. In the claimed invention, the single crystal first group III nitride compound semiconductor, which functions as a seed of crystal growth, is grown on the substrate-exposed portion in a lateral direction in order to obtain the second group III nitride compound semiconductor.

Therefore, Applicant submits that there are elements of the claimed invention that are not taught or suggest by Takeuchi. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. NEW CLAIMS

New claims 58-60 have been added to provide more varied protection for the claimed invention and to claim additional features of the invention. These claims are independently patentable because of the novel features recited therein.

Applicants respectfully submit that new claims 58-60 are patentable over any combination of the applied references at least for analogous reasons to those set forth above with respect to claims 4-17.

IV. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 4-17 and 58-60, all of the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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